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FIG. 7(d).  $\text{SnO}_2$  is converted into metallic Sn in the first charge/discharge cycle, as confirmed from differential charge/discharge curves of  $\text{SnO}_2$ -graphene nanocomposite electrode. In the subsequent charge/discharge cycles, Li ions were reversibly inserted into Sn as Li/Sn alloys ( $\text{LiSn}$  or  $\text{Li}_{4.4}\text{Sn}$ ) as shown in FIG. 9. Pure graphene tested within the same voltage range at current density of 0.004 A/g has a steady capacity of 120 mAh/g. At 40 wt% graphene in the nanocomposites, the capacity from graphene is less than 10% of the total capacity in the  $\text{SnO}_2$ -graphene electrode. The overall capacity of the electrode is mostly from the  $\text{SnO}_2$  active phase.

The specific capacity of the  $\text{SnO}_2$  in the nanocomposite paper as a function of cycle number is shown in FIG. 7(e). The discharge capacity drop in 1<sup>st</sup> cycle is attributed to irreversible conversion of  $\text{SnO}_2$  to Sn and  $\text{Li}_2\text{O}$  upon lithiation. The increase in specific capacity during the initial 10 cycles is attributed to improvement in electrolyte wetting of dense  $\text{SnO}_2$ -graphene nanocomposite electrode and the conversion of  $\text{SnO}_2$  to Sn occurring upon initial lithiation. As the electrode is well wetted by the electrolyte, a steady specific capacity of 625 mAh/g is obtained at a current density of 0.02 A/g (as shown in FIG. 7(e), top). Significantly, the  $\text{SnO}_2$ -graphene nanocomposite electrode shows excellent capacity retention over the charge-discharge cycles in contrast to the rapid degradation of the control  $\text{SnO}_2$ -Super P electrode,  $\text{SnO}_2$ -graphene powder electrode as shown in FIG. 10, and typical  $\text{SnO}_2$  electrode materials. A steady specific capacity of 760 mAh/g for the nanocomposite paper can be obtained at a current density of 0.008 A/g (shown in FIG. 7(e), bottom), close to the theoretical capacity (780 mAh/g). The specific capacities of 225 mAh/g and 550 mAh/g are obtained at a current density of 0.08 A/g and 0.02 A/g (shown in FIG. 7(e), bottom), respectively. At all the charge rates, the specific capacity in nanocomposite papers is well retained during cycling at different rates. The higher capacity and better stability in the nanocomposite electrodes are attributed to good contact between the nanocrystalline  $\text{SnO}_2$  and sandwiched graphene even after conversion and volume change upon lithiation.

High surface area conductive materials with tailored porosity are useful in other energy storage devices such as electrical double layer supercapacitors. These experiments performed a preliminary study on the electrochemical capacitance of the mesoporous  $\text{SiO}_2$ -graphene nanocomposite powder, FIG. 7(f) shows cyclic voltammograms (CV) using a three-electrode configuration for pure graphene and a mesoporous  $\text{SiO}_2$ -graphene nanocomposite. Both graphene and the  $\text{SiO}_2$ -graphene nanocomposite display a capacitive charging current with a rectangular shape across the potential range between -1.0 and 0 V (vs. the saturated Ag/AgCl reference electrode). However, surprisingly the CV response for the nanocomposite with the "inert" silica is significantly enhanced, resulting in a much higher single electrode capacitance of 120 F/g. This value is better than the best result reported in the literature for graphene (about 100 F/g), but the actual specific capacitance for graphene in the nanocomposite is higher (170 F/g) if accounting for the 30 wt% of inert silica. These preliminary studies suggest the improved electrochemical response in the nanocomposites is likely attributed to the open mesoporous network, which prevents aggregation of the graphene sheets on the electrode.

Graphene sheets used in this study were prepared through the thermal expansion of graphite oxide. X-ray photoemission spectroscopy (XPS) of the graphene sheets shows a sharp C1s peak indicating good  $\text{sp}_2$  conjugation.

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While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character. Only certain embodiments have been shown and described, and all changes, equivalents, and modifications that come within the spirit of the invention described herein are desired to be protected. Any experiments, experimental examples, or experimental results provided herein are intended to be illustrative of the present invention and should not be considered limiting or restrictive with regard to the invention scope. Further, any theory, mechanism of operation, proof, or finding stated herein is meant to further enhance understanding of the present invention and is not intended to limit the present invention in any way to such theory, mechanism of operation, proof, or finding.

Thus, the specifics of this description and the attached drawings should not be interpreted to limit the scope of this invention to the specifics thereof. Rather, the scope of this invention should be evaluated with reference to the claims appended hereto. In reading the claims it is intended that when words such as "a", "an", "at least one", and "at least a portion" are used there is no intention to limit the claims to only one item unless specifically stated to the contrary in the claims. Further, when the language "at least a portion" and/or "a portion" is used, the claims may include a portion and/or the entire items unless specifically stated to the contrary. Likewise, where the term "input" or "output" is used in connection with an electric device or fluid processing unit, it should be understood to comprehend singular or plural and one or more signal channels or fluid lines as appropriate in the context. Finally, all publications, patents, and patent applications cited in this specification are herein incorporated by reference to the extent not inconsistent with the present disclosure as if each were specifically and individually indicated to be incorporated by reference and set forth in its entirety herein.

The invention claimed is:

1. An electrode comprising a nanocomposite material having at least two layers, each layer including a metal oxide layer chemically bonded directly to at least one graphene layer wherein the graphene layer has a thickness of about 0.5 nm to 50 nm, the metal oxide layers and graphene layers alternately positioned in the at least two layers forming a series of ordered layers in the nanocomposite material.

2. The electrode of claim 1 wherein said metal oxide is  $\text{M}_x\text{O}_y$ , and where M is Ti, Sn, Ni, Mn, Si, V and/or combinations thereof.

3. The electrode of claim 1 wherein said metal oxide is tin oxide.

4. The electrode of claim 1 wherein said metal oxide has a mesoporous structure.

5. The electrode of claim 1 wherein said nanocomposite material has a specific capacity of greater than about 400 mAh/g.

6. A lithium ion battery having at least two electrodes wherein at least one of said electrodes comprises an ordered nanocomposite material having at least two layers, each layer including a metal oxide layer chemically bonded to at least one graphene layer wherein the graphene layer has a thickness of about 0.5 nm to 50 nm, the metal oxide layers bonded to the graphene layers in the at least two layers to form an ordered nanocomposite material.

7. The lithium ion battery of claim 6 wherein said nanocomposite material has a specific capacity of greater than about 400 mAh/g.